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FLORISTICS OF BEECH-HARDWOOD FOREST IN EAST TEXAS

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ABSTRACT

We studied the floristics and edaphic conditions of Beech-Hardwood Forest in southeastern Texas. While probably rare in presettlement times, the community is now very rare and fragmented due largely to farming and agroforestry. Much of it is degraded and only a few good examples remain.

KEY WORDS: Beech-Hardwood Forest, Sabine National Forest, floristics, Texas

INTRODUCTION

There have been numbers of studies devoted to the woody vegetation of the West Gulf Coastal Plain (WGCP) forests (Christensen 1988; Harcombe, *et al.* 1993; Harcombe & Marks 1977; Marks & Harcombe 1981; Nixon, *et al.* 1980, 1987; Nixon & Cunningham 1985; Ware, *et al.* 1993), but there have been almost none devoted to the herbaceous vegetation (Ajilvsgi 1979; Bridges & Orzell 1989a, 1989b; Harcombe, *et al.* 1993; Kral 1966). There are several reasons for this, not the least being that it is much more time-consuming to inventory the herbaceous layer.

In this paper, we describe the floristics of Beech-Hardwood Forest in the WGCP, with special emphasis on the herbaceous vegetation.

What we term Beech-Hardwood Forest is more technically referred to as American Beech-White Oak (*Fagus grandifolia-Quercus alba*) Series, which is distinguished from the American Beech-Southern Magnolia (*Fagus grandifolia-Magnolia grandiflora*) Series, the major difference being the presence of *Magnolia grandiflora* as a co-dominant in one and its virtual absence from the other (Diamond, *et al.* 1987;

Grace 1993). However, such distinctions are not always met with in the field and, in the present case, from the descriptions it appears that the two communities may not be clearly distinguishable. Consequently, we will simply call the community Beech-Hardwood Forest.

East Texas is the southwestern limit of the once extensive eastern Beech-Hardwood Forest (Logan 1959; McLeod 1972, 1975; Watson 1979). In Texas, this community is limited to mesic, sheltered (protected) ravines where ground water is nearby, usually in the form of a small creek or perennial stream. Beech is a good indicator species, but it is always accompanied by a rich array of other hardwoods (Nixon, *et al.* 1980). Beech may be declining along the southwestern border of its range as suitable protected habitat is fragmented (Logan 1959).

In Texas, Beech-Hardwood Forest is considered to be a threatened community, meaning that there are very few good examples of it remaining (Orzell 1990; Texas Organization for Endangered Species 1992; Texas Natural Heritage Program 1993).

Beech-Hardwood Forest in southeast Texas is found in ravines. The ravines in our study area are V-shaped, in the range of 30 meters deep, and have fairly steep slopes, generally about 20° to 45°, but often locally steeper. They usually lack terraces near the stream bank but may have them higher up.

At ground level, Beech-Hardwood Forest is open, with almost no shrub or midstory layer, but often with a heavy leaf litter. The upper canopy is high above the ground and shades out most light, at least in the growing season. Gaps created by tree fall often result in spectacular herbaceous growth.

One of the interesting things about the herbaceous layer of this community is the seemingly erratic nature of species occurrence. The rich northeastern vernal forb flora associated with Beech-Hardwood Forest is highly localized (Kral 1966); a day of tramping through likely habitat often yields nothing but then, one suddenly comes upon a "northern" woodland with several species such as *Sanguinaria canadensis* L., *Erythronium rostratum* W. Wolf, *Uvularia perfoliata* L., *Silene stellata* (L.) Ait., and perhaps *Cypripedium kentuckiense*. The refugium-like occurrence of these isolated populations cannot be missed (Delcourt & Delcourt 1984; Kral 1966; Webb 1981).

STUDY SITES/METHODS

In 1995 and 1996, we conducted a systematic study of Beech-Hardwood Forest on the Sabine National Forest, Texas. This consisted of an in-depth study of one site and brief surveys of others. The detailed floristic study was done on a 3 ha. site near Sulphur Creek (north of Milam) from February 1996 to November 1996. We visited the site every three weeks.

The Sulphur Creek site is divided by a narrow, perennial, west flowing creek. The study site was a north facing slope (ca. 30°) with extensive rock exposures. We collected and identified all vascular plants encountered.

The dominant trees appeared to be mature to old growth, and although some nearby ravines had old stumps, we believe that cutting in these areas, if it had occurred at all, had been selective, probably the pines. DBH measurements of some of the largest trees at the site showed they clearly fall into the size range of old growth and mature trees (Nixon, *et al.* 1980) (Table 1).

Table 1. DBH of larger trees in Sulphur Creek study site (in cm).

Species	No. trees measured	DBH	
		mean	range
Carya sp.	3	53	(41-58)
Fagus grandifolia Ehrh.	14	63	(41-86)
Fraxinus americana L.	2	58	(51-66)
Pinus taeda L.	2	64	(61-69)
Quercus alba L.	4	58	(48-66)
Q. falcata Michx.	1	56	-
Q. michauxii Nutt.	2	48	(46-51)

Since there is a major light gradient between canopy and ground, we measured light (using a Weston light meter) in Sulphur Creek to get some idea of the extremes of this gradient. On a clear day in July at noon in a gap (direct sunlight), the light measured "20"; whereas in the shade away from the gap, it measured "13." This means that there is less than five percent of the light on the ground in a closed canopy Beech-Hardwood Forest than there is in direct sun. Since the majority of trees in this habitat are deciduous, in the winter the canopy is open. The canopy closes in March and April.

Using topographic maps, we located and surveyed ravines throughout the Sabine National Forest to gather information on abundance, flora, and condition of Beech-Hardwood Forest (see also Orzell 1990).

We follow Kartesz (1994) in most instances of botanical nomenclature. Voucher specimens of many of the species collected are distributed among ASTC, BRCH, LSUS, TEX, and VDB.

While the specific fire history of Sulphur Creek is not known, we found no fire scars, and the leaf litter is deep, suggesting that it had been a very long time since the area has burnt. What the fire regime would have been under natural conditions is not known. The surrounding longleaf pine forest probably burned regularly and slow moving meandering cool ground fires probably regularly entered the ravines in presettlement times, but today, fire is suppressed.

For East Texas, precipitation is generally uniformly distributed throughout the year, averaging about 100 cm. Summers are long and hot; temperatures rise to 35° C, which, combined with short droughts, translates into dry conditions with streams sometimes drying up. Humidity is always high. Winters are mild with very few days of freezing weather (Grace 1993; Nixon, *et al.* 1980; Nixon & Cunningham 1985).

RESULTS

Table 2 lists the vascular plants found in Sulphur Creek.

Table 2. Plants of Sulphur Creek.

ACANTHACEAE - *Yeatesia viridiflora* (Nees) Small

ACERACEAE - *Acer barbatum* Michx., *A. rubrum* L.

ANACARDIACEAE - *Toxicodendron radicans* (L.) Kuntze

ANNONACEAE - *Asimina triloba* (L.) Dunal

APIACEAE - *Sanicula gregaria* Bickn.

AQUIFOLIACEAE - *Ilex longipes* Chapman *ex* Trel., *I. opaca* Ait., *I. vomitoria* Ait.

ARACEAE - *Arisaema dracontium* (L.) Schott, *A. triphyllum* (L.) Schott

ARALIACEAE - *Aralia spinosa* L.

ARISTOLOCHIACEAE - *Aristolochia reticulata* Jacq., *A. serpentaria* L.

ASCLEPIADACEAE - *Asclepias variegata* L.

ASPLENIACEAE - *Asplenium platyneuron* (L.) B.S.P.

ASTERACEAE - *Aster lateriflorus* L., *Elephantopus tomentosus* L., *Hieracium gronovii* L., *Lactuca floridana* (L.) Gaertn., *Senecio obovatus* Muhl. *ex* Willd., *Solidago auriculata* Schuttlw. *ex* Blake, *Solidago caesia* L.

BERBERIDACEAE - *Podophyllum peltatum* L.

BETULACEAE - *Carpinus caroliniana* Walt., *Ostrya virginiana* (P. Mill.) Koch

BLECHNACEAE - *Woodwardia areolata* (L.) T. Moore

BORAGINACEAE - *Cynoglossum virginianum* L., *Lithospermum tuberosum* Rugel. *ex* DC.

BRASSICACEAE - *Dentaria laciniata* Muhl. *ex* Willd.

CAPRIFOLIACEAE - *Lonicera japonica* Thunb., *L. sempervirens* L., *Viburnum acerifolium* L., *V. dentatum* L., *V. rufidulum* Raf.

CARYOPHYLLACEAE - *Silene stellata* (L.) Ait.

CELASTRACEAE - *Euonymus americana* L.

CLUSIACEAE - *Hypericum frondosum* Michx.

COMMELINACEAE - *Tradescantia hirsutiflora* Bush

CORNACEAE - *Cornus florida* L.

CYPERACEAE - *Carex albicans* Willd. *ex* Spreng., *C. amphibola* Steud., *C. blanda* Dewey, *C. debilis* Michx., *C. digitalis* Willd., *C. rosea* Schkuhr. *ex* Willd., *C. striatula* Michx.

DIOSCOREACEAE - *Dioscorea villosa* L.

DRYOPTERIDACEAE - *Athyrium filix-femina* (L.) Roth, *Polystichum acrostichoides* (Michx.) Schott

ERICACEAE - *Monotropa uniflora* L., *Vaccinium elliottii* Chapman

EUPHORBIACEAE - *Euphorbia corollata* L., *Sebastiana fruticosa* (Bartr.) Fern.

FABACEAE - *Cercis canadensis* L., *Desmodium nudiflorum* (L.) DC.

FAGACEAE - *Fagus grandifolia* Ehrh., *Quercus alba* L., *Q. falcata* Michx., *Q. michauxii* Nutt., *Q. phellos* L.

HAMMAMELIDACEAE - *Hamamelis virginiana* L.

HIPPOCASTANACEAE - *Aesculus pavia* L.

IRIDACEAE - *Sisyrinchium albidum* Raf.

JUGLANDACEAE - *Carya alba* (L.) Nutt. *ex* Ell.

JUNCACEAE - *Juncus effusus* L., *Luzula echinata* (Small) Herm.

LAMIACEAE - *Salvia lyrata* L., *Scutellaria elliptica* Muhl. *ex* Spreng.

LILIACEAE - *Erythronium rostratum* W. Wolf, *Smilax glauca* Walt., *S. pumila* Walt., *S. smallii* Morong, *Trillium gracile* J.D. Freeman, *Uvularia perfoliata* L.

LOGANIACEAE - *Spigelia marilandica* (L.) L.

MAGNOLIACEAE - *Magnolia grandiflora* L.

MORACEAE - *Morus rubra* L.

NYSSACEAE - *Nyssa sylvatica* Marsh.

OLEACEAE - *Fraxinus americana* L.

OPHIOGLOSSACEAE - *Botrychium biternatum* (Sav.) Underwood, *B. virginianum* (L.) Sw.

ORCHIDACEAE - *Listera australis* Lindl., *Tipularia discolor* (Pursh) Nutt.

OROBANCHACEAE - *Epifagus virginiana* (L.) W. Bart.

PAPAVERACEAE - *Sanguinaria canadensis* L.

PASSIFLORACEAE - *Passiflora lutea* L.

PHRYMACEAE - *Phryma leptostachya* L.

PINACEAE - *Pinus echinata* P. Mill., *P. taeda* L.

PLATANACEAE - *Platanus occidentalis* L.

POACEAE - *Arundinaria gigantea* (Walt.) Muhl., *Brachyelytrum erectum* (Schreb. *ex* Spreng.) Beauv., *Chasmanthium sessilifolium* (Poir.) Yates, *Dichanthelium boscii* (Poir.) Gould & Clark, *D. scoparium* (Lam.) Gould, *Melica mutica* Walt.

POLEMONIACEAE - *Phlox divaricata* L.

POLYPODIACEAE - *Polypodium polypodioides* (L.) Walt.

PORTULACACEAE - *Claytonia virginica* L.

RHAMNACEAE - *Berchemia scandens* (Hill) K. Koch, *Rhamnus caroliniana* Walt.

ROSACEAE - *Agrimonia microcarpa* Wallr., *Crataegus marshallii* Eggles., *C. spathulata* Michx., *Geum canadense* Jacq.

RUBIACEAE - *Galium aparine* L., *G. circaezans* Michx., *Mitchella repens* L.

STYRACACEAE - *Styrax grandifolius* Ait.

THELYPTERIDACEAE - *Phegopteris hexagonoptera* (Michx.) Fee

TILIACEAE - *Tilia americana* L.

VERBENACEAE - *Callicarpa americana* L.

VIOLACEAE - *Viola palmata* L. var. *triloba* (Schwein.) Gingins *ex* DC., *V. langloisii* Greene, *V. walteri* House

VITACEAE - *Parthenocissus quinquefolia* (L.) Planch., *Vitis mustangensis* Buckl., *V. riparia* Michx., *V. rotundifolia* Michx.

There were 120 species, 91 genera, and 63 families in the Sulphur Creek site, making it as species rich as many other WGCP communities, *e.g.*, bogs (Nixon & Ward 1986).

Table 3 gives information on two soil samples from Sulphur Creek (see also Nixon, *et al.* 1980).

Table 3. Soil chemistry of Sulphur Creek.

Sample	pH	Exchangeable Ions (ppm)				OM%
		P	K	Ca	Mg	
Sul 1	5.6	3	100	660	144	2.8
Sul 2	5.3	6	71	220	64	4.1

SURVEY

We surveyed ravines over the extent of the Sabine National Forest. Our survey was by no means random, but was aimed at locating high quality habitat and rare species; using topographic maps we selected the steepest sites for initial inspection. We did not repeat earlier surveys (Orzell 1990). These surveys convinced us that the deeper and steeper ravines harbor the best examples of Beech-Hardwood Forest and have the greatest variety of rare species: *Brachyelytrum erectum, Dentaria laciniata, Cypripedium kentuckiense, Erythronium rostratum, Lilium michauxii* Poir., *Sanguinaria canadensis, Solidago auriculata, Thaspium trifoliatum, Trillium gracile*, and *Uvularia perfoliata.*

The highest quality ravines occur in a band through the center of the Sabine National Forest, running NW to SE. They parallel the Shelby-San Augustine county line where it dips southeast at its eastern edge northwest of San Augustine and runs just north of Geneva and Milam. Kral (1966) located many northern woodland herbs in the tributaries of the Palo Gaucho Bayou area east of San Augustine. Other rich areas include the ravines east of Ragtown, near Toledo Bend Reservoir, and the ravines south of East Hamilton, again on the Toledo Bend Reservoir (Orzell 1990).

The reasons for this distribution seem to be fairly obvious. These are the deepest and steepest ravines on the Forest and thus are the most protected. Many may have never been logged, and certainly logging was seldom as extensive here as in the pine-dominated uplands.

In 1993 and 1994, we surveyed some ravines in the Kisatchie National Forest, Louisiana. Many of these had Beech-Hardwood Forest similar to that found in Texas. Rare species encountered in them include *Corallorhiza wisteriana* Conrad, *Cypripedium kentuckiense, Erythronium rostratum, Hexalectris spicata* (Walt.) Barnh., *Hydrangea quercifolia* Bartr., *Lilium michauxii, Monotropa hypopithys* L., *Obolaria virginica* L., *Solidago auriculata, Triphora trianthophora* (Sw.) Rydb., *Trillium gracile*, and *Uvularia perfoliata* (MacRoberts & MacRoberts 1995).

DISCUSSION

Kral (1966) surveyed many ravines in east Texas and northern Louisiana. He was struck by the presence of what he called "northern woodland elements" south of their normal range and speculated on their occurrence in this area. He commented on the fact that the species appeared to be clones rather than dispersed populations. Apparently most of the rare species were not reproducing sexually, but primarily vegetatively, perhaps even more so than normally occurs in many of these species (Whigham 1974). Kral was struck by the size and infrequency of the populations: walk in ravines for miles without finding anything, then a large patch of *Erythronium rostratum* or *Sanguinaria canadensis*. He proposed a refugium explanation for their occurrence; that is, these populations are probably Ice Age holdovers hanging on precariously to the older geologic terraces in the coolest locations in the forest. Reproduction, certainly by sexual outcrossing, has probably ceased, and plants spread by vegetative means.

The pattern Kral describes clearly fits what we have found, with the possible addition that at a few sites, several rare species occur together. This is the case at Sulphur Spring where *Brachyelytrum erectum, Sanguinaria canadensis, Dentaria laciniata, Trillium gracile, Erythronium rostratum*, and *Uvularia perfoliata* either occur together or in close proximity.

Kral (pers. comm.) makes the interesting suggestion that these northern species may be holding on in ravines that have not only cold-air drainage down them, but have places where such air pools, and it is in these areas, if still forested, that provide spots favorable to their continuance.

One very important thing that should be mentioned about Beech-Hardwood Forest, one that is particularly significant for its management, and this is light levels. The herbaceous layer is adapted to low levels of light and early timing of growth and flowering. For example, *Uvularia perfoliata* blooms before closure of the forest canopy (Whigham 1974). Further, and singularly important for management, is that changing light intensities by opening up the canopy leads to the rapid demise of such species as *Uvularia*. "If the over-head canopy was completely removed, it is doubtful

that any population would survive for more than a few years" (Whigham 1974:357). Maintaining the canopy and the integrity of the natural, low light levels is absolutely necessary to the survival of the herbaceous species in this community. This means more than the preservation of trees directly above, but also of those on the upper sloes, which are often pines, that contribute to reducing light levels downslope.

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